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Contributions of depression and body mass index to body image

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ABSTRACT

Depression and body mass index (BMI) are known to be associated with body image, however, their independent or joint effects on body image in adults are largely unknown. Therefore, we studied associations of depression diagnosis, severity, and BMI with perceptual body size (PBS) and body image dissatisfaction (BID). Cross-sectional data from 882 remitted depressed patients, 242 currently depressed patients and 325 healthy controls from the Netherlands Study of Depression and Anxiety were used. Depressive disorders (DSM-IV based psychiatric interview), standardized self-reported depressive symptoms (Inventory of Depressive Symptomatology) and BMI were separately and simultaneously related to body image (the Stunkard Figure Rating scale) using linear regression analyses. Thereafter, interaction between depression and BMI was investigated. Analyses were adjusted for demographic and health variables. Higher BMI was associated with larger PBS ($B = 1.13$, $p < .001$) and with more BID ($B = 0.61$, $p < .001$). Independent of this, depression severity contributed to larger PBS ($B = 0.07$, $p < .001$), and both current ($B = 0.21$, $p = .001$) and remitted depression diagnosis ($B = 0.12$, $p = .01$) as well as depression severity ($B = 0.11$, $p < .001$) contributed to BID. There was no interaction effect between BMI and depression in predicting PBS and BID. In general, depression (current, remitted and severity) and higher BMI contribute independently to a larger body size perception as well as higher body image dissatisfaction. Efforts in treatment should be made to reduce body dissatisfaction in those suffering from depression and/or a high BMI, as BID can have long-lasting health consequences, such as development of anorexia and bulimia nervosa and an unhealthy lifestyle.

1. Introduction

Depression and obesity are among the most prevalent and disabling disorders worldwide, both causing major public health problems (Ferrari et al., 2013; World Health Organisation (WHO), 2013). They have also been consistently associated, and this association appears to be bidirectional (De Wit et al., 2010; Faith et al., 2011; Luppino et al., 2010). The negative impact of depression and obesity on social and occupational functioning, somatic health, and a healthy lifestyle is substantial (Field et al., 2004; Lenz et al., 2009; Neovius et al., 2009; Ormel et al., 1999; Penninx et al., 2013; Phelan et al., 2015; Sikorski et al., 2011; Smith and Smith, 2016; Van Gool et al., 2007). In addition, both depression and obesity are associated with distorted perceptual and attitudinal body image (Marsella et al., 1981; Noles et al., 1985; Weinberger et al., 2016). Distorted body image has been associated with a number of unfavorable consequences, such as worse psychosocial functioning (Cash and Fleming, 2001; Davison and McCabe, 2006), poorer health behavior (Grogan, 2006; Schlissel et al., 2017; Stice and Shaw, 2003), and anorexia and bulimia (Cash and Brown, 1987; Gardner and Brown, 2014; Garner and Garfinkel, 1981). However, it is not known whether depression and obesity jointly affect body image, and whether their combined associations might be greater than the separate associations of depression and obesity with body image. Modifying body image could be an important target in depression treatment (Beck, 1976), especially in individuals with a high BMI. However, in adults, associations between depression, obesity and body image have never been properly investigated, and the joint association of depression and obesity remains unknown.

Body image is defined as a person's body-related self-perceptions and self-attitudes, including body-related thoughts, feelings, and

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behaviors (Cash, 2004). The concept of body image includes at least two components: perceptual body size (i.e., estimation of one's body size, which can be distorted when different from actual body size) and attitudinal body image (i.e., affective, cognitive, and behavioral concerns with one's body size) (Rucker and Cash, 1992). Attitudinal body image comprises aspects of body image dissatisfaction, shape and weight concerns and overvaluation of body shape and weight (Bulik et al., 2001; Grilo, 2013; Lynch et al., 2009, 2007; Masheb and Grilo, 2003). These attitudinal body image constructs are related, but distinct.

The majority of the research on associations between depression and body image has focused on adolescents, and found associations between both depressive disorder and depressive symptoms and distorted body image (Roberts and Duong, 2013; Stice et al., 2000). Of the few previously published studies on the associations between depression and body image in adults, only one studied patients with major depressive disorder as established by formal diagnostic criteria versus healthy controls (Pimenta et al., 2009), but failed to find significant associations. The other studies operationalized depression by using one overall symptom severity score (Friedman et al., 2002; Goldschmidt et al., 2016; Jackson et al., 2014; Masheb and Grilo, 2003; Richard et al., 2016), all finding significant associations between higher depression severity and greater body image dissatisfaction.

Dissatisfaction with body image seems palpable in those who suffer from obesity and rather unconventional in individuals with a normal body weight (Weinberger et al., 2016). However, findings from some studies are more counterintuitive, as they showed no association between BMI and body image dissatisfaction (Sarwer et al., 2005). It has been suggested that this might be due to differences in stigmatizing experiences (Puhl and Heuer, 2009), or to the fact that in certain individuals, continuation of weight loss or gain beyond a certain threshold does not lead to further changes in dissatisfaction (Sarwer et al., 2005). Another factor possibly influencing the BMI-body image association is depression. As depression and obesity have been consistently and bidirectionally associated (De Wit et al., 2010; Faith et al., 2011; Luppino et al., 2010), and are shown to have overlapping genetic bases (Hyde et al., 2016), it can be expected that they may augment the effect of one other. It might also be expected that associations between depression and body image are most pronounced in normal weight individuals, as in those with obesity, body image dissatisfaction may be already high, thereby reducing the influence of depression on body image in individuals with obesity (Weinberger et al., 2016). One former study in adolescents found depression to be associated with body image dissatisfaction only in normal and overweight groups (Chen et al., 2015), however an adult study found depression to be associated with more body dissatisfaction across all BMI groups (Richard et al., 2016). Another recent study also found associations between depression, BMI, and body image dissatisfaction, in female undergraduates, including these variables in a single model (Stevens et al., 2017). No information was provided on possible interactions between depression and BMI. As both separate and joint associations of depression and BMI with body image remain unclear, the aim of the current study is to examine whether depressive disorder, depressive symptoms, and BMI are associated with both perceptual body size and body image dissatisfaction. As a second aim, the joint associations of depression and obesity on perceptual body size and body image dissatisfaction were investigated.

2. Materials and methods

2.1. Study sample

Data from the Netherlands Study of Depression and Anxiety (NESDA), an ongoing cohort study of persons with depressive and anxiety disorders and healthy controls were used. In order to represent diverse settings and developmental stages of psychopathology, 2981 adults (18–65 year) from the community (19%), general practice (54%) and specialized mental health care (27%) were included at baseline. Exclusion criteria were a primary clinical diagnosis of psychotic disorder, obsessive-compulsive disorder, bipolar disorder, or severe substance abuse disorder, and insufficient command of the Dutch language. The research protocol was approved by the Ethical Committees of the contributing universities and all participants provided written informed consent. A detailed description of the NESDA study design can be found elsewhere (Penninx et al., 2008). Between September 2004 and February 2007, all participants underwent a baseline assessment containing an extended face-to-face interview conducted by a trained research assistant, which included a standardized diagnostic psychiatric interview (Composite International Diagnostic Interview (CIDI) version 2.1 (Wittchen, 1994),), blood sampling and self-report questionnaires. Approximately every 2 years after the baseline assessment, face-to-face follow-up assessments were conducted. Follow-up assessments had a response of 87.1% (N = 2596) at 2-year follow-up, 80.6% (N = 2402) at 4-year follow-up, 75.7% (N = 2256) at 6-year follow-up, and 69.4% (N = 2069) at 9-year follow-up. This paper is based on data of the 9-year follow-up wave in which body image was measured. Data of earlier waves were used to create psychiatric status groups. We excluded participants with pure current or pure remitted anxiety disorders without depression diagnosis (n = 195), those on whom data on psychiatric disorders was inconclusive due to too many missing CIDI follow-up data (n = 13), and participants with missing data on the body image questionnaire (n = 378). Finally, we also excluded those with underweight (BMI < 18.5), due to a small sample (n = 31), and because it can be expected that underweight participants represent a specific group that differs from those with normal BMI or overweight. Thus, our final sample contained 1452 participants. Those with missing data on the body image variable were at the 9-year follow-up significantly younger ($p < .001$), more often male ($p = .03$), had a lower education ($p = .01$), experienced more severe depressive symptoms ($p = .01$) and had more often a diagnosis of current ($p < .001$) or remitted ($p = .02$) depression. No differences in BMI were found.

2.2. Depression measurements

During each assessment, presence of a DSM-IV depressive (MDD, dysthymia) or anxiety disorder (panic disorder with or without agoraphobia, generalized anxiety disorder, social phobia, agoraphobia) was established using the CIDI (Wittchen, 1994). At the 9-year follow up, all participants were classified as either 1) a control subject, 2) having a remitted disorder, or 3) having a current diagnosis based on information from baseline to 9-year follow up. Control subjects were defined as having no lifetime history of depressive or anxiety disorders at all. Persons in the remitted group had a lifetime history of depression disorder but no diagnosis in the past 6 months as diagnosed with the CIDI, and current patients had diagnosed depressive disorder (major depressive disorder, dysthymia) in the past 6 months.

At 9-year follow-up, severity of depressive symptoms in the past week was assessed with the 30-item Inventory of Depressive Symptomatology - Self Report (IDS-SR, range 0–84 (Rush et al., 1996);). Items were scored from 0 (‘no problems’) to 3 (‘severe problems’) and a sum score was computed and standardized. In order to further improve clinical interpretability, the sum score was categorized into 5 standard categories: none (score 0–13), mild (score 14–25), moderate (score 26–38), severe (score 39–48) and very severe (≥ 49) (Rush et al., 1996).

2.3. Body image measurements

Figure ratings to compose body image categories were obtained at the 9-year follow-up using the Stunkard Adult Figure Rating Scale, which consists of nine adult female/male silhouettes increasing in size from very thin (one) to very heavy (nine). Subjects were asked to “circle the silhouette that looks most like you” (item 1) and “circle the silhouette that best shows how you would like to look” (item 2) (Stunkard et al., 1983). From these responses, we obtained the variables

"perceptual body size" (item 1: values 1–9) and "perceived ideal body size" (item 2: values 1–9) respectively, as was done previously (Jackson et al., 2014; Lynch et al., 2009, 2007).

Body image dissatisfaction was defined as perceptual body size minus perceived ideal body size (Lynch et al., 2009, 2007). A score closer to 0 in either direction represents low body image dissatisfaction, whereas a score farther away from 0 in either direction represents high body image dissatisfaction. In accordance with previous studies (Jackson et al., 2014; Lynch et al., 2009), three body image dissatisfaction categories were made: persons who want to bigger silhouette (≤ -2), persons who are satisfied (-1 to 1), persons who want a smaller silhouette (≥ 2). As only 3 participants scored $< =$-2, we decided to drop this category because it can be expected that this group differs in underlying pathology from those who are satisfied or unsatisfied because they want to have a smaller silhouette. Thus, body image dissatisfaction was used as a dichotomous variable (satisfied versus want to have a smaller silhouette). Body image dissatisfaction was also used as a continuous variable, combining the groups who scored -1 and 0 as done by Fitzgibbon et al. (2000) and Lynch et al. (2007).

2.4. Sociodemographic and lifestyle and health variables

The socio-demographic variables age, sex, years of education and ethnicity were assessed during the interview. The lifestyle and health variables included in this study were kept similar to the variables included in previous studies to improve comparability. Lifestyle and health variables were measured at 9-year follow-up and contained smoking, alcohol use, body mass index (BMI) and chronic diseases. Smoking was operationalized by number of cigarettes per week. Alcohol use was expressed in number of drinks per week. Body weight and body height were measured at each visit by a trained research assistant. BMI was calculated as weight kilograms divided by height squared in meters (kg/m^2). Three BMI categories were made: normal weight (BMI 18.5–24.9), overweight (BMI 25–29.9) and obesity (BMI > 29.9). The number of self-reported current somatic diseases for which participants received medical treatment (i.e. heart disease, epilepsy, diabetes, osteoarthritis, stroke, cancer, chronic lung-disease, thyroid disease, liver disease, intestinal disorders and ulcers) were counted.

2.5. Statistical analyses

Nine-year follow-up sample characteristics were described as means and standard deviations, or percentages.

Unadjusted linear regression analyses were performed to assess whether depression diagnosis (with healthy controls as the reference category), depression severity and continuous BMI were associated separately to perceptual body size and in a second analysis, body image dissatisfaction. For the regression analyses, depression severity and BMI were standardized to make effects comparable. Thereafter, multivariable models were made for each of the independent variables, depression diagnosis, depression severity or BMI, adjusted for age, gender, years of education, ethnicity, smoking, alcohol use and number of chronic diseases. Finally depression diagnosis or severity were combined with BMI in the same model, along with potentially confounding variables (i.e. age, gender, education, ethnicity, smoking, alcohol use, and number of chronic diseases).

To conduct the main analyses with complete data of the variables included in the current analyses, first, multiple imputation was performed. In our final study sample (N = 1449), there were 191 missing values on BMI. These missing values were assumed to be missing completely at random, as there were no systematic differences between the missing values and the observed values. With use of the SPSS multiple imputation procedure, 5 imputations were obtained as this should give an efficiency of 99% compared to using an infinite number of imputations (Rubin, 1987). Variables which were non-normally distributed were log transformed before entered in the multiple imputation, and back transformed afterwards. In line with the guidelines for multiple imputation as described by Sterne et al. (2009), the following variables were included in the multiple imputation procedure: age, gender, years of education, ethnicity, BMI of all the assessments (year 0 till year 9), cigarette and alcohol use, number of chronic diseases, depression diagnosis and severity, and the variables perceptual body size and perceived ideal body size.

Hereafter, to further investigate the potential interaction between depression and BMI, it was tested whether the interaction term between depressive diagnosis or depression severity * continuous BMI was significantly associated with perceptual body size or body image dissatisfaction as outcome. Depression diagnosis or severity and BMI were also included in these analyses. To illustrate the results of these analyses, histograms were made to visualize the mean perceptual body size and mean rates of dissatisfaction of depression diagnosis groups or IDS clinical category groups, across the three BMI categories.

The regression coefficients reported in this paper were based on multiple imputed data, and were combined using Rubin's Rules (Rubin, 1987). As an additional analysis, we ran the analyses on the original data without imputations. As some previous papers included body image dissatisfaction as a dichotomous variable (Jackson et al., 2014; Lynch et al., 2009, 2007), and this might be a clinically relevant measure, we also reran all analyses using dichotomous instead of continuous body image dissatisfaction. Before running the analyses, it was briefly tested whether the interaction term between depressive diagnosis or depressive symptoms * gender was significantly associated with perceptual body image or body image dissatisfaction as outcome.

Analyses were conducted using SPSS version 22.0 (IBM Corp., Armonk, NY, USA). A p-value of $< .05$ was considered statistically significant.

3. Results

3.1. Descriptives

Participant's mean age was 51.8 (SD = 13.1). Of the three depression diagnosis groups, the healthy control group had the lowest percentage of females (59.2%) and the highest number of years of education (M = 13.9, SD = 3.2, Table 1). The healthy controls had a mean BMI of 25.9 (SD = 4.8), the remitted patients on average 26.4 (SD = 4.7), and the current patients had a BMI of 27.0 (SD = 5.1), BMI was not significantly different across groups. Current patients contained the most smokers (25.7%), and had relatively the highest number of chronic diseases. As expected, current patients also showed the highest severity of depressive symptoms. Significant differences between patients and healthy controls were also found for body image. On a scale from 1 to 9, the average perceptual body size in the healthy control group was 4.3 (SD = 4.1), in the remitted group it was 4.5 (SD = 1.4), and for the current patients 4.7 (SD = 1.4). In the healthy control group, 79.0% of the participants were satisfied with their body size, as compared to 70.1% of the remitted and 64.1% of the current patients.

3.2. Depression, BMI and perceptual body size

Unadjusted linear regression analyses showed that patients with a remitted depressive disorder as well as with those with a current depressive disorder perceive their body size as larger as compared to the healthy controls (Table 2, model 1). Higher depression severity was also associated to a higher perceptual body size, and those with a higher BMI also perceived their body size as being larger. After correction for sociodemographic and lifestyle variables, only BMI, but not depression diagnosis or severity, was associated to perceptual body image (Table 2, model 2). When adding both depression diagnosis and BMI into the analyses simultaneously, results showed only BMI to remain associated

Table 1
Sample characteristics for complete cases (NESDA cohort at 9 year follow-up).

	Controls N = 325	Remitted depressive disorders N = 882	Current depressive disorders N = 242	Total group N = 1449	p-value
Demographics					
Age (mean, sd)	51.1 (14.6)	52.2 (12.9)	52.1 (11.6)	51.8 (13.1)	.50
Gender (%, female)	59.2	69.6	69.4	67.2	.002
Education (mean, sd)	13.9 (3.2)	12.9 (3.1)	12.7 (3.2)	13.1 (3.3)	< .001
Ethnicity (%, North European)	96.7	96.0	95.1	96.0	.63
Lifestyle and health					
BMI (mean, sd)	26.0 (4.8)	26.5 (4.7)	27.0 (5.1)	26.5 (4.8)	.06
Smoking (%)	12.3	24.6	25.7	22.0	< .001
No. cigarettes/day (median,IQR)	63.0 (82.5)	70.0 (84.0)	70.0 (119.0)	70.0 (70.0)	.22
Alcohol use (drinks/week) (median, IQR)	3.7 (7.2)	3.7 (8.0)	1.0 (8.2)	3.7 (8.0)	.52
No. chronic diseases (%)					< .001
0	57.1	40.0	34.3	42.9	
1-2	37.8	49.8	53.5	47.7	
> 2	5.1	10.2	12.2	9.4	
Severity of depressive symptoms (mean, sd)	6.2 (5.2)	14.5 (9.5)	28.9 (12.5)	15.0 (11.7)	< .001
None	90.4	53.6	10.8	54.6	< .001
Mild	8.9	33.4	31.4	27.4	
Moderate	0.7	11.2	36.3	13.2	
Severe/very severe	0	1.7	21.5	4.6	
Body size perception (mean, sd)	4.3 (1.3)	4.5 (1.4)	4.7 (1.4)	4.48 (1.42)	< .001
Body image dissatisfaction (mean, sd)	0.9 (0.9)	1.1 (0.9)	1.3 (1.0)	1.1 (0.9)	< .001
0–1 (%)	78.5	70.6	63.6	71.2	.001
≥ 2 (%)	21.5	29.4	36.4	28.8	

IQR = inter quartile range.

to perceptual body size (Table 2, model 3). Adding depression severity and BMI into the analyses simultaneously showed both to be associated to perceptual body size (Table 2, model 4).

3.3. Depression, BMI and body image dissatisfaction

Unadjusted linear regression analyses showed that both patients with a remitted and a current depressive disorder had higher body image dissatisfaction than the healthy controls (Table 2, model 1). Higher depression severity and higher BMI were also associated to greater dissatisfaction. This remained unchanged after correction for sociodemographic and lifestyle variables (Table 2, model 2). When depression diagnosis and BMI were added into the analyses simultaneously, both depression diagnosis and BMI remained associated with body image dissatisfaction (Table 2, model 3). Adding depression severity and BMI simultaneously into the analyses also showed both to be associated to body image dissatisfaction (Table 2, model 4).

We studied whether the association between depression and body

Table 2
Linear regression analyses examining the associations of depression diagnosis, depression severity and BMI with perceptual body size or body image dissatisfaction (N = 1449).

	Perceptual body size							
	Unadjusted Model 1		Covariate adjusted Model 2		Covariate adjusted, depression diagnosis & BMI entered Model 3		Covariate adjusted depression severity & BMI entered Model 4	
	B[a]	*p*-value	B[a]	*p*-value	B[a]	*p*-value	B[a]	*p*-value
Depression diagnosis								
Healthy controls	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	n.a.	n.a.
Remitted patients	0.24	.01	0.09	.31	0.07	.25	n.a.	n.a.
Current patients	0.45	< .001	0.21	.08	0.14	.08	n.a.	n.a.
Depression severity	0.17	< .001	0.04	.30	n.a.	n.a.	0.07	.007
BMI (kg/m^2)	1.11	< .001	1.13	< .001	1.13	< .001	1.13	< .001
	Body image dissatisfaction							
Depression diagnosis								
Healthy controls	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	n.a.	n.a.
Remitted patients	0.09	.002	0.13	.03	0.12	.01	n.a.	n.a.
Current patients	0.21	< .001	0.25	.002	0.21	.001	n.a.	n.a.
Depression severity	0.18	< .001	0.10	< .001	n.a.	n.a.	0.11	< .001
BMI (kg/m^2)	0.60	< .001	0.60	< .001	0.61	< .001	0.61	< .001

Characteristics are entered into the univariable unadjusted regression analyses separately first (model 1). Thereafter, multivariate analyses are done for depression diagnosis, depression severity or BMI separately, adjusted for age, gender, years of education, ethnicity, smoking, alcohol use and number of chronic diseases (model 2). Finally, multivariate analyses are done separately for depression diagnosis (model 3) and depression severity (model 4) together with BMI, adjusted for age, gender, years of education, ethnicity, smoking, alcohol use and number of chronic diseases.

[a] B represents standardized regression coefficients.

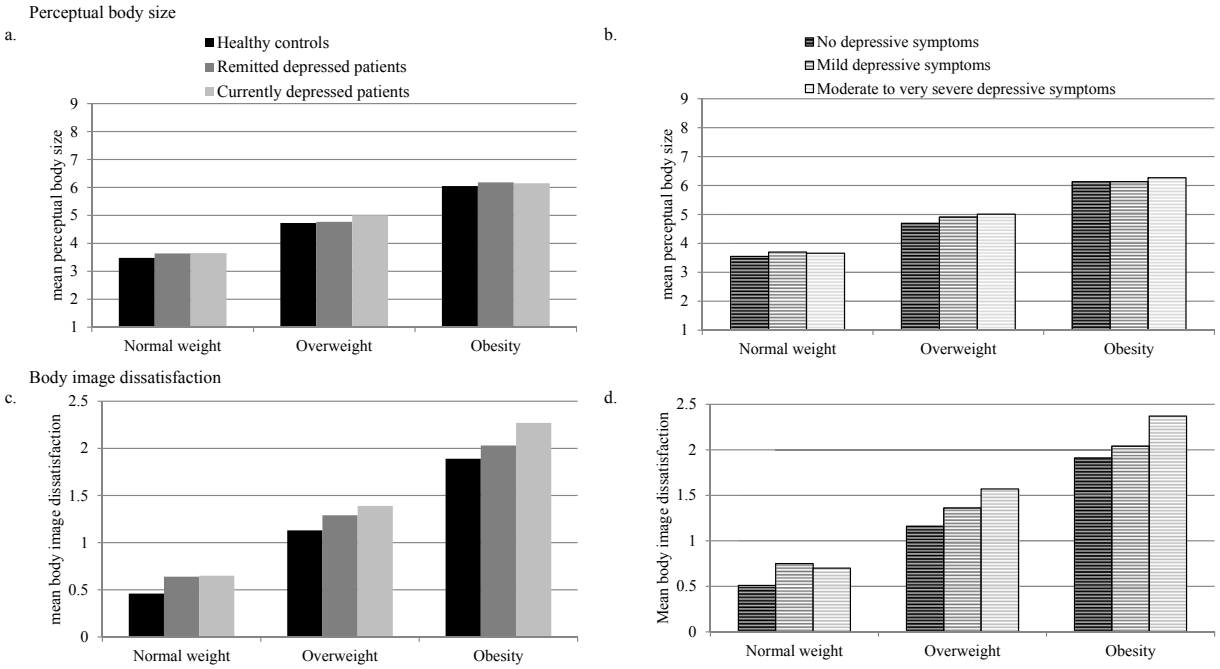

Fig. 1. Associations between a.) depression diagnosis and perceptual body image, b.) depression severity and perceptual body image, c.) depression diagnosis and body image dissatisfaction and d.) depression severity and body image dissatisfaction, per BMI category (normal weight n = 662, overweight n = 496, obesity n = 291).

image differed between BMI groups by testing the interaction terms between depression * BMI and associating those terms with perceptual body size and body image dissatisfaction. The interaction tests indicated that the association between depression diagnosis or depression severity and perceptual body size did not differ with BMI level (p-values were .70 and .19 for remitted and current depression interaction terms, and .42 for depression severity interaction term). Likewise, associations between depression diagnosis or severity and body image dissatisfaction did not differ with BMI (p-values .68, .49 and .90 for depression diagnosis and severity respectively). This was illustrated by histograms in Fig. 1, that showed that, as compared to healthy controls and remitted patients, the current patient group showed to have the largest perceptual body size and the largest mean dissatisfaction. This was true for all BMI categories (normal weight, overweight and obesity). Results for IDS symptom categories similarly showed that, as compared to those with none or mild symptoms, those with moderate to (very) severe symptoms showed the largest perceptual body size and highest frequency of dissatisfaction. This was true for overweight and obese BMI categories.

Using dichotomous body image dissatisfaction instead of the continuous variable, showed similar results (Table 3), as did using complete cases in the analyses (data not shown). No significant interaction terms were found between depression diagnosis or severity and gender in associations with perceptual body size or body image dissatisfaction (p-values between .14 and .74) suggesting that associations were consistent across men and women.

Table 3
Logistic regression analyses examining the associations between depression diagnosis, depression severity and BMI, and dichotomous body image dissatisfaction (N = 1449).

	Body image dissatisfaction							
	Unadjusted Model 1		Covariate adjusted Model 2		Covariate adjusted, depression diagnosis & BMI entered Model 3		Covariate adjusted depression severity & BMI entered Model 4	
	OR[a]	*p*-value	OR[a]	*p*-value	OR[a]	*p*-value	OR[a]	*p*-value
Depression diagnosis								
Healthy controls	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	n.a.	n.a.
Remitted patients	1.59	.003	1.23	.13	1.43	.07	n.a.	n.a.
Current patients	2.11	< .001	1.54	.04	1.66	.04	n.a.	n.a.
Depression severity	1.41	< .001	1.24	.001	n.a.	n.a.	1.44	< .001
BMI (kg/m^2)	5.25	< .001	6.00	< .001	6.04	< .001	6.22	< .001

Characteristics are entered into the univariable unadjusted regression analyses separately first (model 1). Thereafter, multivariate analyses are done for depression diagnosis, depression severity or BMI separately, adjusted for age, gender, years of education, ethnicity, smoking, alcohol use and number of chronic diseases (model 2). Finally, multivariate analyses are done separately for depression diagnosis (model 3) and depression severity (model 4) together with BMI, adjusted for age, gender, years of education, ethnicity, smoking, alcohol use and number of chronic diseases.

[a] OR = Odds Ratio for standardized coefficients.

4. Discussion

In this large-scale cohort study, we found robust associations between depression, higher BMI and both larger perceptual body size as well as greater body image dissatisfaction. We are the first to show that when combining depression severity and BMI in one model, both were significantly associated to higher perceptual body size and to more body image dissatisfaction. Similarly, when combining depression diagnosis and BMI in one model, both were significantly associated to more body image dissatisfaction. BMI was more strongly associated to both perceptual body image and body image dissatisfaction than depression. Our results also show that associations of depression with perceptual body size and body image dissatisfaction are similar across different BMI levels.

The results of this study are in line with previous findings that show associations between depression severity and both perceptual body size and body image dissatisfaction (Friedman et al., 2002; Goldschmidt et al., 2016; Jackson et al., 2014; Masheb and Grilo, 2003; Richard et al., 2016). We are the first to study associations between depression diagnosis and body image dissatisfaction in adults. In accordance with the "scar hypothesis", research has shown depression to leave lasting changes in cognitions such as dysfunctional attitudes (e.g. personalization, overgeneralization) and attributional style (attribute negative events to internal, stable, and global causes) (Eaves and Rush, 1984; Lewinsohn et al., 1981; Nolen-Hoeksema et al., 1992; Rohde et al., 1990). In Becks classical theory of depression, "distortion of body image" is included among the cognitive symptoms of depression (Beck, 1976)). Therefore, it might be that depression could contribute to a worse body image. However, the theoretical framework in adolescents states that distorted body image due to changing body shapes can contribute to depression (Roberts and Duong, 2013; Stice et al., 2000). Thereby, previous evidence suggests that the association between depression and body image might be bidirectional. It is also possible that both depression and body image dissatisfaction are caused by a third factor. For example, a study with female students showed that experiencing weight stigma due to a high BMI was associated with both depressive symptoms as well as body image dissatisfaction (Stevens et al., 2017).

In accordance with a recent systematic review and meta-analysis (Weinberger et al., 2016), we found associations between a higher BMI and both a larger perceptual body size and more body image dissatisfaction. When depression and BMI were combined in one model, only associations between BMI and perceptual body size remained significant. Associations between high BMI and a larger perceptual body size have been reported earlier (Benkeser et al., 2012; Cachelin et al., 2006; Gilbert-Diamond et al., 2009; Kakeshita and de Sousa Almeida, 2006) and overestimation of body size in individuals with obesity is found (Johnstone et al., 2008). It is however an interesting finding that this association seems irrespective of mood. As changes in cognition due to depression could also contribute to a higher perception, the joint effects of both BMI and depression could have led to an even higher perceptual body size. No previous studies specifically focused on the joint associations of depression and BMI on perceptual body size. However, Pimenta et al. (2009) included the results of both variables and did adjust for BMI when associating depression to perceptual body size (Pimenta et al., 2009). Their results are in line with the current findings, as after adjustment for BMI and sociodemographic variables, no significant association between depression diagnosis and perceptual body size was found (Pimenta et al., 2009). For body image dissatisfaction, in the current study, in models containing both depression and BMI, the associations of both BMI and depression with body image dissatisfaction remain significant. Also, while both depression and BMI are associated to body image dissatisfaction, the effect of BMI is the strongest. Goldschmidt et al. (2016), Masheb and Grilo (2003) and Richard et al. (2016) previously studied associations between depressive symptoms and body image dissatisfaction and adjusted these analyses for BMI. In line with our findings, results of all three studies showed that depression was significantly associated to body image dissatisfaction after adjustment for BMI and other sociodemographic variables (Goldschmidt et al., 2016; Masheb and Grilo, 2003; Richard et al., 2016). Because the associations of BMI with body image dissatisfaction were not reported, we could not compare the association of BMI with body image dissatisfaction. In the current study, overall no significant interaction between depression and BMI was found, and associations between depression and body image were consistent across BMI levels. As no other studies investigated the interaction of depression and BMI in association with body image, it is not possible to compare our results with previous findings. The results of the current study suggest that body image dissatisfaction could be a target in the treatment of those who suffer from depression in combination with a high BMI. Modifying dysfunctional body image-related thoughts, feelings, and behaviors (Alleva et al., 2015), could subsequently reduce adverse mental and physical health consequences such as low self-esteem (Cash and Fleming, 2001; Davison and McCabe, 2006), eating disorders (Cash and Brown, 1987; Gardner and Brown, 2014; Garner and Garfinkel, 1981), physical inactivity, alcohol use and smoking (Grogan, 2006; Schlissel et al., 2017; Stice and Shaw, 2003).

There are some important strengths to the present study, such as the use of a large generalizable group of participants, recruited from community, general practice and specialized mental health care, and the fact that it is the first study to investigate associations between depression diagnosis and body image dissatisfaction in an adult population. Additionally, body weight was measured by a trained interviewer rather than using self-reported weight. However, some limitations should also be noted. The main limitation concerns the validity of the Stunkard Adult Figure Rating scale (Stunkard et al., 1983) as an accurate measure of a body image dissatisfaction. Whereas in general women tend to internalize a thin appearance ideal (Thompson and Stice, 2001), for men the ideal body is one of lean muscularity (Blashill and Wilhelm, 2015; McCreary and Saucier, 2009). The Figure Rating scale may not be precise enough to distinguish between overweight or obesity and muscularity. Although in the current study sex did not significantly modify the associations between depression and body image dissatisfaction and we presented results for men and women combined, women tended to be more dissatisfied than men. Studies of Friedman et al. (2002), Goldschmidt et al. (2016) and Pimenta et al. (2009) do present stratified results, however they do not perform statistical tests to validate the necessity (Friedman et al., 2002; Goldschmidt et al., 2016; Pimenta et al., 2009). We believe it is necessary to first 'proof' that there is truly evidence of gender modification by testing gender interaction. As these studies didn't do so, it remains difficult to compare results. Furthermore, no information on experience of weight stigma or social stigma was available, while studies suggest strong associations between stigma and both depression (Brohan et al., 2011; Stevens et al., 2017) and obesity (Puhl and Heuer, 2009; Stevens et al., 2017). Finally, while the associations between depression and body image might be bidirectional, this study relied on cross-sectional data and thereby no conclusions about causality can be made.

In summary, our findings are the first to indicate that patients with a remitted or current depressive disorder are more frequently dissatisfied with their body. We also confirm that those with higher depression severity, as well as those with a higher BMI, are more often dissatisfied. Persons with a high symptom severity and/or high BMI also seem to perceive their body as larger. BMI seems to be more strongly associated to both outcomes than depression. Associations between depression and body image did not vary across BMI levels. Given the current findings, efforts in treatment should be made to reduce body image dissatisfaction in those suffering from depression, especially in those with a high BMI, as body image dissatisfaction can have long-lasting consequences in both mental and physical health.

Declarations of interest

None.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.jpsychires.2018.05.003.

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